| UČNI NAČRT PREDMETA / COURSE SYLLABUS (leto / year 2017/18) | | | |
|---|---|---|---|
| **Predmet:** | Optimizacija | | |
| **Course title:** | Optimization | | |
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| **Študijski program in stopnja<br>Study programme and level** | **Študijska smer<br>Study field** | **Letnik<br>Academic year** | **Semester<br>Semester** |
| Visokošolski strokovni študijski program Praktična matematika | ni smeri | 3 | prvi |
| First cycle professional study programme Practical Mathematics | none | 3 | first |

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| **Vrsta predmeta / Course type** | obvezni / compulsory |
| | |
| **Univerzitetna koda predmeta / University course code:** | M0429 |

| **Predavanja<br>Lectures** | **Seminar<br>Seminar** | **Vaje<br>Tutorial** | **Klinične vaje<br>work** | **Druge oblike študija** | **Samost. delo<br>Individ. work** | **ECTS** |
|---|---|---|---|---|---|---|
| **45** | | **45** | | | **120** | **7** |

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| **Nosilec predmeta / Lecturer:** | prof. dr. Sergio Cabello Justo, prof. dr. Emil Žagar, prof. dr. Arjana Žitnik |

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| **Jeziki / Languages:** | **Predavanja / Lectures:** | slovenski / Slovene |
| | **Vaje / Tutorial:** | slovenski / Slovene |

| **Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:** | **Prerequisites:** |
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| Vpis v letnik študija. | Enrolment in the programme. |
| **Vsebina:** | **Content (Syllabus outline):** |

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| Optimizacijske naloge in problemi, primeri. Lokalna optimizacija.<br><br>Linearni programi, standardna oblika in pretvorbe.<br><br>Metoda simpleksov, splošni korak, začetna dopustna rešitev, končnost metode, geometrijski opis.<br><br>Dualnost pri linearnem programiranju, šibka in krepka dualnost.<br><br>Matrične igre.<br><br>Problem razvoza. Celoštevilske rešitve.<br><br>Problem maksimalnega pretoka. Algoritem Forda in Fulkersona. Izrek o maksimalnem pretoku in minimalnem prerezu.<br><br>Prirejanja in pokritja v dvodelnih grafih. Razporejanje opravil in madžarska metoda.<br><br>Najkrajše poti v grafih. Dijkstrov algoritem. Floyd-Warshallov algoritem. Uporaba algoritmov za najkrajše poti, na primer kitajski problem poštarja.<br><br>Računalniška orodja za reševanje optimizacijskih problemov. | Optimization problems, examples.<br>Local optimization.<br><br>Linear programming, the standard form and conversions among different forms.<br><br>The simplex method, iteration step, initial feasible solution, termination, geometric interpretation.<br><br>The dual problem, weak and strong duality.<br><br>Matrix games.<br><br>The transshipment problem. Integer solutions.<br><br>Maximum flow problem. Ford-Fulkerson algorithm. Max-flow- min-cut theorem.<br><br>Matchings and coverings in bipartite graphs. The assignment problem and the Hungarian method.<br><br>Shortest paths in graphs. Dijkstra's algorithm. Floyd-Warshall algorithm. Application of shortest paths algorithms to practical problems such as the Chinese postman problem.<br><br>Software tools for solving optimization problems. |

**Temeljni literatura in viri / Readings:**

V. Chvátal: Linear Programming, Freeman, New York, 1983.

B. H. Korte, J. Vygen: Combinatorial Optimization : Theory and Algorithms, 3. izdaja, Springer, Berlin, 2006.

R. J. Vanderbei: Linear Programming : Foundations and Extensions, 2. izdaja, Kluwer, Boston, 2001.

| **Cilji in kompetence:** | **Objectives and competences:** |
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| Študentje bodo spoznali pojem optimizacijskega problema, se naučili zapisati probleme iz prakse v obliki optimizacijskih problemov in se natančneje seznanili z reševanjem linearnih optimizacijskih problemov. | Students encounter the notion of an optimization problem and learn how to model various problems which appear in practice as optimization problems, with emphasis on solving linear optimization problems. |

| **Predvideni študijski rezultati:** | **Intended learning outcomes:** |
|---|---|
| Znanje in razumevanje: Slušatelj je sposoben z matematičnim modelom dobro opisati različne probleme iz vsakdanjega življenja. Poudarek je na problemih, ki vodijo do linearnih modelov. Pozna osnovne prijeme za učinkovito reševanje dobljenih optimizacijskih problemov.<br><br>Uporaba:<br><br>Reševanje optimizacijskih problemov iz vsakdanjega življenja.<br><br>Refleksija:<br><br>Pomen predstavitve praktičnih problemov v formalizirani obliki za njihovo učinkovito in pravilno reševanje.<br><br>Prenosljive spretnosti – niso vezane le na en predmet:<br><br>Modeliranje nalog iz vsakdanjega življenja v obliki matematičnih optimizacijskih nalog, zmožnost razločevanja med računsko obvladljivimi in neobvladljivimi problemi. | Knowledge and understanding:<br>Students are able to model various problems which appear in practice accurately. The emphasis is on the problems that lead to linear models. They are familiar with the basic techniques that can be used to solve the resulting optimization problems efficiently.<br><br>Application:<br>Solving optimization problems which appear in practice.<br><br>Reflection:<br>The importance of representing practical problems in a formal way which helps to solve them efficiently and adequately.<br><br>Transferable skills:<br>Ability to model practical problems as mathematically formulated optimization problems, ability to distinguish between computationally feasible and infeasible problems. |

| **Metode poučevanja in učenja:** | **Learning and teaching methods:** |
|---|---|
| predavanja, vaje, domače naloge, konzultacije | Lectures, exercises, homeworks, consultations |

Delež (v %) /

| **Načini ocenjevanja:** | Weight (in %) | **Assessment:** |
|---|---|---|
| Način (pisni izpit, ustno izpraševanje, naloge, projekt):<br><br>domače naloge<br><br>izpit iz vaj (2 kolokvija ali pisni izpit)<br><br>izpit iz teorije<br><br>Študentje dobijo dve oceni:<br><br>eno iz vaj (pisnega izpita in domačih nalog), drugo iz teorije. Opravljen izpit iz vaj je pogoj za pristop k izpitu iz teorije.<br><br>Ocene: 1-5 (negativno), 6-10 (pozitivno) (po Statutu UL) | <br><br><br><br><br><br><br><br><br><br><br><br>50%<br><br>50% | Type (examination, oral, coursework, project):<br><br>homework<br><br>2 midterm exams instead of written exam, written exam<br><br>oral exam<br><br>Students receive two grades: one from the written exam and homeworks, and the other from the oral exam.<br><br>Grading: 1-5 (fail), 6-10 (pass) (according to the Statute of UL) |

**Reference nosilca / Lecturer's references:**

Sergio Cabello:

CABELLO, Sergio, DÍAZ-BÁÑEZ, José Miguel, PÉREZ LANTERO, Pablo. Covering a bichromatic point set with two disjoint monochromatic disks. Computational geometry, ISSN 0925-7721. [Print ed.], 2013, vol. 46, iss. 3, str. 203-212. [COBISS.SI-ID 16326233]

CABELLO, Sergio, GIANNOPOULOS, Panos, KNAUER, Christian, MARX, Dániel, ROTE, Günter. Geometric clustering: fixed-parameter tractability and lower bounds with respect to the dimension. ACM transactions on algorithms, ISSN 1549-6325, 2011, vol. 7, no. 4, article 43 (27 str.). [COBISS.SI-ID 16028761]

CABELLO, Sergio, ROTE, Günter. Obnoxious centers in graphs. SIAM journal on discrete mathematics, ISSN 0895-4801, 2010, vol. 24, no. 4, str. 1713-1730. [COBISS.SI-ID 15762265]

Emil Žagar:

JAKLIČ, Gašper, KANDUČ, Tadej, PRAPROTNIK, Selena, ŽAGAR, Emil. Energy minimizing mountain ascent. Journal of optimization theory and applications, ISSN 0022-3239, 2012, vol. 155, is. 2, str. 680-693. ,. [COBISS.SI-ID 4382935]

JAKLIČ, Gašper, ŽAGAR, Emil. Curvature variation minimizing cubic Hermite interpolants. Applied mathematics and computation, ISSN 0096-3003. [Print ed.], 2011, vol. 218, iss. 7, str. 3918-3924.

[COBISS.SI-ID 16049241]

JAKLIČ, Gašper, ŽAGAR, Emil. Planar cubic G [sup] 1 interpolatory splines with small strain energy. Journal of Computational and Applied Mathematics, ISSN 0377-0427. [Print ed.], 2011, vol. 235, iss. 8, str. 2758-2765. [COBISS.SI-ID 15770969]

Arjana Žitnik:

MILANIČ, Martin, PISANSKI, Tomaž, ŽITNIK, Arjana. Dilation coefficient, plane-width, and resolution coefficient of graphs. Monatshefte für Mathematik, ISSN 0026-9255, 2013, vol. 170, no. 2, str. 179-193. [COBISS.SI-ID 1024499540]

PISANSKI, Tomaž, ŽITNIK, Arjana. Representing graphs and maps. V: BEINEKE, Lowell W. (ur.), WILSON, Robin J. (ur.). Topics in topological graph theory, (Encyclopedia of mathematics and its applications, ISSN 0953-4806, 128). Cambridge [etc.]: Cambridge University Press, cop. 2009, str. 151-180. [COBISS.SI-ID 15227481]

ŽITNIK, Arjana. Series parallel extensions of plane graphs to dual-eulerian graphs. Discrete Mathematics, ISSN 0012-365X. [Print ed.], 2007, vol. 307, iss. 3-5, str. 633-640. [COBISS.SI-ID 14183769]